

DEFINIENS[®]
Understanding Images

DEEPER INSIGHTS
FASTER RESULTS
BETTER DECISIONS

Definiens Enterprise Image Intelligence™ Suite



The Image Analysis Challenge

From studying distant galaxies to probing minute biological structures on earth, scientists rely on images to understand the environment. But interpreting images is an immensely complex and challenging task.

The human mind has a remarkable ability to make sense of images, extracting objects, patterns and insights from them. It handles ambiguous or partial information by making inferences based on the image as a whole, the relationship between individual objects and the intelligent use of external, contextual information.

Scientists, doctors and image analysts hone their skills over years in a specific field, building a personal knowledge base which they intuitively apply when interpreting images. It is this vast experience of similar but not identical situations that enables them to make acute judgments in ambiguous or challenging situations.

It is not surprising that computers have found the challenge of nontrivial image analysis almost impossible to solve.

Automated image analysis

Attempts to automate image analysis and information extraction have been continuing for decades. But despite increases in computational power and imaging capabilities, fundamental advances in automated image analysis have been limited.

The heart of the problem is that for any image there may be many plausible interpretations and there is no way to determine the correct interpretation with absolute certainty. The difficulties take the form of varied shading and colors, partially-hidden objects and determining three-dimensional depth from two-dimensional projections.

Experienced analysts resolve these ambiguities with a high degree of accuracy. But how can a computer duplicate what goes on in the brain of a human being?

Definiens Cognition Network Technology®

Definiens Cognition Network Technology® has been developed by Gerd Binnig, the 1986 Nobel Laureate for Physics, and his team. It emulates human cognitive processes, extracting intelligence from images.

To emulate the human mind's cognitive powers, Definiens made a radical departure from conventional approaches. Using patented segmentation and classification processes, Definiens has developed a robust method of rendering knowledge in a semantic network.

The technology examines pixels not in isolation, but in context. It builds up a picture iteratively, recognizing groups of pixels as objects. Just like the human mind, it uses the color, shape, texture and size of objects as well as their context and relationships to draw the same conclusions and inferences that an experienced analyst would draw.

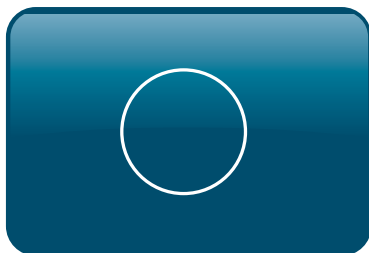
The result is the world's leading solution for fast, accurate information extraction from any kind of image - from earth observation satellite images to non-invasive body scans, tissue samples and cell-based assays.

The principles of Definiens Cognition Network Technology®

Definiens Cognition Network Technology® is context-based and identifies objects rather than simply examining individual pixels. It then makes inferences about those objects by looking at them in context.

The following simplified example illustrates how Definiens Cognition Network Technology® works.

Q What is this?



A A circle inside a rectangle



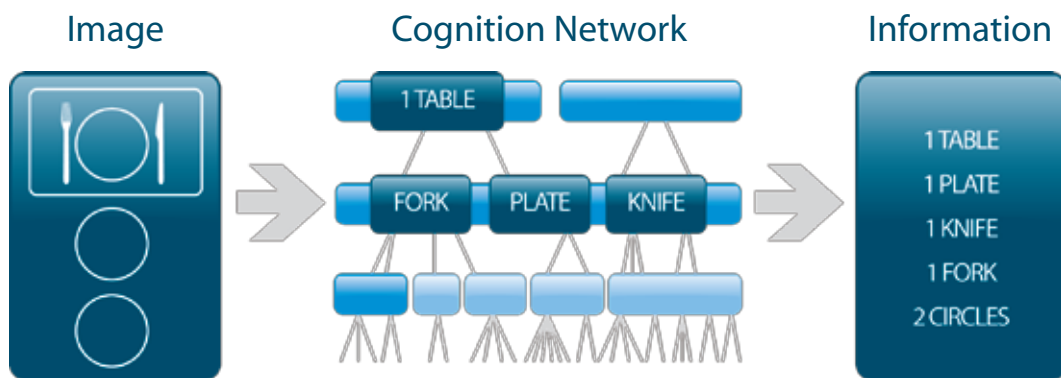
B A Plate

With the addition of a knife and fork, the circle is immediately identified as a plate. The circle hasn't changed, but the human mind uses context and relationships with other objects to make intelligent inferences. This is how Definiens Cognition Network Technology® works.

The value of Definiens Cognition Network Technology®

Definiens Cognition Network Technology® is the only technology that classifies and analyzes imagery using all the semantic information required to interpret it correctly. Rather than examining individual pixels in isolation, it distills meaning from the objects' connotations and mutual relations.

Of course, Definiens Cognition Network Technology® recognizes pixel information. But it adds significant value to this information by creating a powerful cognition network. This dramatically enhances the value of intelligence that can be extracted from the image and which, in turn, can be fully quantified and qualified to answer the user's specific questions.



Capturing domain expertise

The power of Definiens Cognition Network Technology® is its ability to transform user knowledge and domain expertise into automatic routines, enabling it to process millions of images.

Definiens Cognition Network Technology® can accomplish even the most challenging image intelligence tasks. Its open and flexible architecture accommodates any number of clients and servers enabling it to make the most of image analysis across the entire enterprise.

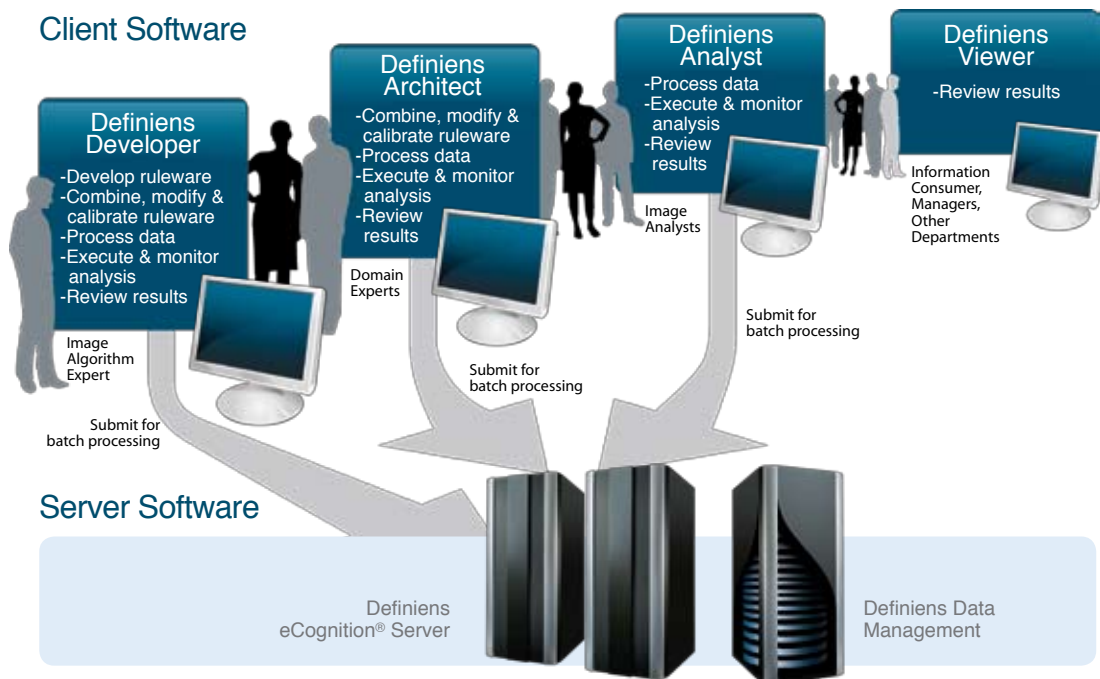
Definiens Enterprise Image Intelligence™ Suite

Definiens Enterprise Image Intelligence™ Suite is the platform on which image analysis applications are built and executed.

The Definiens Enterprise Image Intelligence™ Suite enables unrivalled image analysis across a huge range of applications - be they basic viewing and analysis, semi-automated click-and-classify object detection or high-volume batch processing.

The Definiens Enterprise Image Intelligence™ Suite is highly scalable and features a modular design. It is used across a huge range of industries - pharmaceuticals, biotechnology, healthcare, defense and security, oil and gas, resource planning - indeed every industry where image analysis plays a critical role.

The Definiens Enterprise Image Intelligence™ Suite comprises role-based products which meet the needs of any image-based business process.



The Definiens Enterprise Image Intelligence™ Suite comprises four role-based products that run on the Definiens eCognition® Server.

Definiens eCognition® Server

The heart of the Definiens Enterprise Image Intelligence™ Suite, the Definiens eCognition® Server enables organizations to deploy powerful image analysis applications in a high-performance computing environment. The server offers unlimited scalability, a web-based control service and resource management console, and automatic jobscheduling capabilities.

Definiens Developer

Definiens Developer is a powerful, integrated development environment for creating new image analysis applications. Developers enjoy unrestricted access to the full functionality of Definiens Cognition Network Technology®, as well as development and workflow tools enabling rapid development of new applications. Definiens Developer incorporates all the functionality of Definiens Analyst and Definiens Architect and comes with a SDK.

Definiens Architect

Definiens Architect contains all the tools required to configure powerful image analysis applications. Featuring an intuitive graphics-based interface, Definiens Architect includes a library of building blocks or modules which users select to build the application they want. Definiens Architect requires no programming skills yet enables users to create versatile image analysis applications tailored to a specific dataset or business process.

Definiens Analyst

Definiens Analyst is a powerful data processing application that runs on the Definiens eCognition® Server and enables users to control, manage and analyze massive datasets. Easy-to-use workflow tools control importing, manipulating, navigating, reviewing and validating.

Definiens Viewer

Definiens Viewer enables users and managers to review the results of every image analysis. This powerful interpretive instrument provides easy-to-use workflow tools for importing, manipulating, navigating, reviewing, validating and exporting the results of analyses.

Definiens in Life Sciences

Definiens' technology is ideally suited to life sciences where image analysis causes bottlenecks in many areas of drug development.

Definiens' technology has the power to liberate scientists from the laborious task of image analysis and focus on their real goal - understanding the world and combating disease through the development of new and more effective drugs.

Translational medicine

Definiens' technology is used across the entire lifecycle of drug development, helping bioscience and pharmaceutical companies to analyze vast numbers of images quickly, accurately and consistently.

In the pre-clinical stage, Definiens is used in safety assessments to eliminate drug candidates, reducing the huge cost of clinical trials. It is a powerful tool for identifying and tracking biomarkers, supporting proof-of-mechanism, proof-of-principle and proof-of-concept studies.

Furthermore, because Definiens is built on a robust and open platform it supports translational medicine, enabling results at every stage of drug development to be compared.

Three key applications

There are three key applications of Definiens' technology in life sciences:

- **Cell-based assays:** Technologies such as automated microscopy generate vast quantities of image data containing a wealth of information. The challenge is to capture this information and use it to make informed decisions during drug development. Definiens' technology provides a comprehensive system for analyzing cell-based and high-content assays.
- **Histopathology:** In the pre-clinical development of a potential new drug, the most expensive aspect of its safety assessment is the screening of tissue slides. Definiens' technology offers automated digital pathology applications that deliver accurate and consistent results. The scalable platform can handle image analysis tasks of any size, quickly, accurately and consistently.
- **Non-Invasive Imaging:** Diagnostic imaging is a fast, non-invasive way to examine bones and organs and identify the early stages of cancers or brain disorders. However, in many cases, differential diagnosis is not clear cut; the extent of a malignancy may be difficult to determine and an early stage cancer can easily escape attention. Definiens' technology offers the only solution that classifies and analyzes imagery using all the semantic information required to interpret it correctly.

Deployed around the world

Of the 20 largest pharmaceutical companies in the world, 14 of them are already Definiens' customers. So too are many bioscience companies and research institutions in US and Europe. Definiens' technology supports their research and development programs, bring them insights that speed up drug development and decrease late stage attrition.

Definiens in Earth Sciences

Definiens-based applications can interpret satellite and aerial images and create accurate, GIS-ready information for:

- Defense and Security
- Infrastructure planning
- Natural resource management

Definiens works with all image and geospatial data

Definiens-based applications have been developed for all modern remote sensing instruments including SAR, Lidar, panchromatic, multispectral and hyperspectral sensors mounted on satellite and aerial platforms.

The technology ensures consistent quality, extraordinary detail and high throughput, all at significantly lower cost than manual analysis. It even correlates image analysis with a variety of intelligence sources to provide deeper insight and ensure reliable situation awareness.

Three key applications

There are three key applications of Definiens' technology in earth observation and remote sensing:

- **Rapid Mapping and Feature Extraction:** Highly automated mapping provides a fast, accurate and up-to-date overview of remote terrain which assists in the planning of defense and humanitarian aid operations, infrastructure planning and natural resource management.
- **Change Detection:** Broad area change detection identifies changes over any period of time helping, for example, to monitor variations of vegetation due to climate change, measure the increased percentage of sealed area within cities for urban planning or assess the progress of reconstruction following disasters.
- **Object Detection and Target Recognition:** Definiens-based applications detect real world objects within images, determining their position, shape and dimensions, as well as other attributes like the relation of objects to each other. These attributes make Definiens' technology extremely powerful for civil and military security tasks, helping to detect threats to critical infrastructure like pipelines, track moving objects and simplify the target recognition process.

Deployed around the world

Earth Sciences organizations all along the value chain – data providers, service providers and end users – as well as governments and research organizations rely on Definiens to bridge the gap between remote sensing and Geographical Information Systems (GIS). By correlating image analysis with other geospatial information Definiens enables them to generate, with minimum manual intervention, accurate GIS-ready information.

The Definiens Edge

Definiens Cognition Network Technology® surpasses every other automated image analysis system today across nine different criteria delivering deeper insights, faster results and better decisions.

Deeper Insights

Definiens handles complex real world situations.

The multi-scale object network can explore an image, the objects in it and the relations between them simultaneously on multiple levels. The technology can even detect anomalies like cars queuing up in front of a building or abnormal cells in a tumor.

Definiens supports all common types of imaging systems.

Definiens' technology interprets all types and combinations of digital image data. In the geospatial intelligence arena this covers spaceborne and airborne sensors including panchromatic, multispectral and hyperspectral optical images, infrared, LIDAR, single channel, multifrequency and multipolarimetric SAR. In life sciences, it includes all the major automated microscopes, digital slide scanners and noninvasive imaging scanners.

Definiens provides detailed quantification of images.

Definiens' powerful data structures allow extraction of the relevant data at the right time without the need for complex and time consuming post processing. The extraction can be fully automated.

Faster Results

Definiens' applications can be developed in a fast and modular way.

Applications can be developed rapidly by combining existing ruleware modules. Complex tasks can be addressed with the full power of Definiens Cognition Network Technology®, which in turn creates ruleware that can easily be reused in other situations.

Definiens' applications identify the most important images and the objects of interest within them.

Definiens' applications identify the most important images and the relevant objects and structures within them even under difficult circumstances and in difficult cases. The technology is massively scaleable and is capable of automatically processing large, high resolution images.

Definiens enables scientists and analysts to extract information rapidly.

User-friendly interfaces assist scientists, analysts and informaticians to extract information in fully automated and semi-automated modes.

Better Decisions

Definiens provides reliable information for decision making.

The easy-to-use knowledge base creates a fully transparent extraction process. The deterministic approach ensures all results are fully reproducible. The results of the analysis can be presented in the format best suited for the decision making process: as an object saved in a database, documented in an object-based html report or summarized in a statistical presentation.

Definiens integrates image intelligence across existing processes.

Definiens' technology integrates easily into any environment. As a result, it supports end-to-end intelligence processes across the entire enterprise. In life sciences, this facilitates translational medicine. In earth sciences, it maximizes the combined value of intelligence from all sources.

Definiens will continue to lead the field.

The unique patented software, built on an open standards-based architecture, represents a new paradigm in automated image analysis. Gerd Binnig and his team continue to lead the research and development at Definiens, ensuring that the technology will remain at the forefront of enterprise image intelligence.

DEFINIENS[®]

Understanding Images

DEEPER INSIGHTS
FASTER RESULTS
BETTER DECISIONS

Definiens is the number one Enterprise Image Intelligence™ company for analyzing and interpreting images on every scale, from microscopic cell structures to satellite images.

The patented Definiens Cognition Network Technology®, developed by Nobel Laureate Prof. Gerd Binnig and his team, emulates human cognitive processes of perception to extract intelligence from images. If you are interested in learning more about how Definiens could address the challenges you face, please visit our website.

www.definiens.com

Corporate Headquarters

Definiens AG
Trappentreustraße 1
80339 München
Germany
Tel. +49 (0)89 231180-0

Americas Headquarters

Definiens Inc
55 Madison Avenue, Suite 400
Morristown, NJ 07960
USA
Tel +1-973-285-3291

L1-P-012008

Copyright © 2008 Definiens AG. Definiens, Definiens Cellenger, Definiens Cognition Network Technology, Definiens eCognition, Definiens Enterprise Image Intelligence and Understanding Images are trademarks or registered trademarks of Definiens in the United States, the European Community, or certain other jurisdictions.

All registered trademarks, pending trademarks, or service marks are property of their respective owners. The information in this document is subject to change without notice and should not be construed as a commitment by Definiens AG. Definiens AG assumes no responsibility for any errors that may appear in this document.

